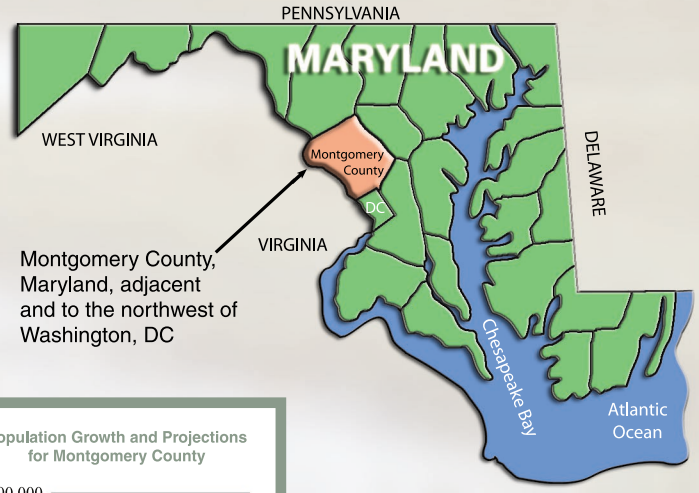
EPA
United States
Environmental Protection
Agency

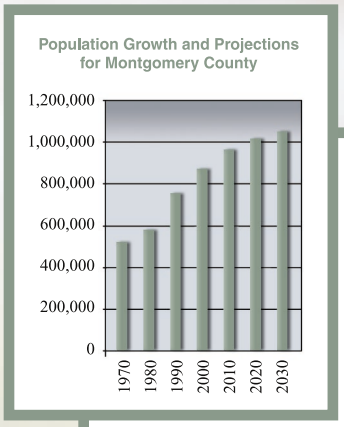
Montgomery County, Maryland Uses Biological Monitoring to Better Understand and Manage Watersheds

Background

Montgomery County faced a growing problem that has confronted local governments across the country: the cumulative impacts that population growth and resulting land-use changes are having on local streams and their accompanying ecosystems.

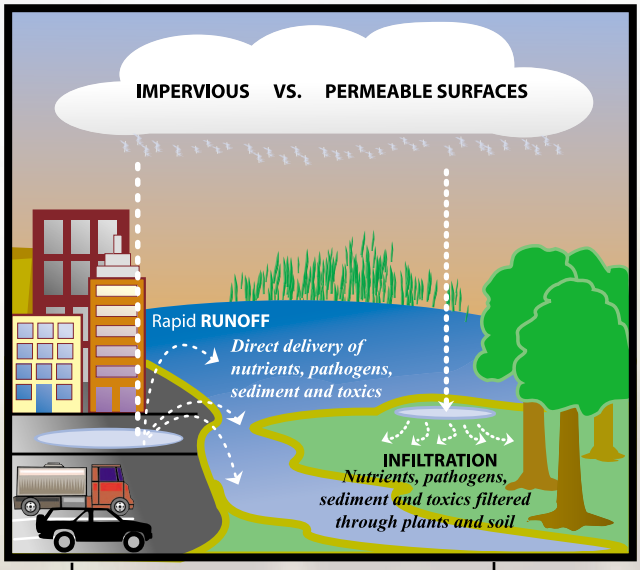
Land-use change brings with it an increase of impervious (non-absorbent/non-permeable) surfaces. Studies show that stream health is directly related to imperviousness. As imperviousness increases, stream and groundwater health decreases.





Montgomery County has:

- Higher household income than most counties in the country
- Resources for biomonitoring and traditional monitoring
- Very little "heavy" industry
- Environmental compliance problems from small shops and industries
- Multi-media public environmental educational program



As ***IMPERVIOUSNESS*** *increases, quality decreases.*

Imperviousness	STREAMS	Permeability
	Pollutants ↓	
	Erosion ↓	
	Sedimentation ↓	
	Flooding ↓	
	Aquatic Life ↑	
	Temperature ↔	
	GROUNDWATER	
	Infiltration ↑	
	Pollutants ↓	
	Supply ↑	

As ***PERMEABILITY*** *increases, quality increases.*

Montgomery County stopped collecting data on its streams during the 1980s when only chemical and physical tests of the water were available. Many of these tests were expensive and did not measure the cumulative impacts observable in county streams. County officials needed an affordable tool to serve as a report card for stream health. Local community groups in Montgomery County had begun using biological monitoring (biomonitoring) techniques – drawing upon knowledge of the abundance and diversity of plant and animal life in local streams – to monitor stream health. Federal and state agencies were also recommending biomonitoring as a cost-effective tool to assess the cumulative impacts in streams and rivers. Living things integrate and reflect the effects of physical, chemical and biological stressors, and can be a major asset for evaluating ecological condition.

Program Development

Montgomery County began its biomonitoring program in 1994. At that time, a wide assortment of many different biological monitoring methods were in use by Maryland agencies. No one method was recommended over the others. Montgomery County formed a work group to develop methods (protocols) that followed those recommended by EPA's Office of Water, in *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers*, http://www.epa.gov/owow/monitoring/rbp/ch01main.html.

Provisional Montgomery County IBI

Invertebrate IBI	Fish IBI
Total number of taxa	Total number of species
Biota Index	Total number of riffle benthic insectivores
Ratio of scrapers (scrapers + filtering collectors)	Total number of minnow species
Proportion of hydropsyche and cheumatopsyche/total EPT individuals	Total number of intolerant species
Proportion dominant taxa	Proportion of tolerant individuals
Total number of EPT taxa	Proportion of omnivores/generalists
Proportion of total EPT individuals	Proportion of pioneering species
Proportion of shredders	Total number of individuals (excluding tolerants)
	Proportion of disease

In 1995, with guidance from the EPA Biological Criteria Team, the County began developing an Index of Biotic Integrity or IBI on an eco-region basis. Benthic macroinvertebrate (bottom dwelling insects) and fish IBIs reflect the structure and function of these communities as compared to those in the reference streams. Reference streams are the highest quality streams found within the County and surrounding areas and are generally found in heavily forested and less developed areas. Streams rated excellent or good by the IBIs are considered healthy. Excellent streams are comparable to the highest quality reference streams and good streams are comparable to the remainder of the reference streams. Poor streams are considered unhealthy compared to reference streams. These Indexes have several measures that describe stream health. For example, the number of species (a measure of community structure), the feeding mode (a measure of community function), pollution sensitivity, and proportion of introduced species, provides a picture of overall ecological stream health. (See the Technical Appendix of *From the Mountains to the Sea – The State of Maryland's Freshwater Streams*, EPA/903/R-99/023, http://www.epa.gov/maia, for a more detailed explanation of the development of fish and benthic IBIs.) The County is in the process of finalizing the two interim indexes it developed, one for stream fish and one for benthic macroinvertebrates.

Montgomery County uses both targeted and probability-based (random) sampling to support different management needs. Sites are selected in one of three ways: (1) sections of streams (reaches) are randomly selected and sites are randomly chosen within each section (reach), (2) sections of streams (reaches) are targeted and sites are randomly chosen on the reach, or (3) both reaches and sites are targeted. For the purposes of developing integrated estimates of stream condition, only the probability-based samples (selection methods 1 and 2) can be used. Targeted sites are useful for other purposes (particularly to diagnose causes of stream degradation at specific local sites), but do not support area estimates with known precision. Over time, Montgomery County is shifting to random selection of reaches and sites, but will continue to employ some targeted reaches and fixed sites for detection of trends in stream condition.

Photo by: B. Batemen

Figure 1. Tony Prochaska, Maryland Department of Natural Resources, demonstrates techniques to measure stream gradient as part of a joint effort with local governments to insure data quality through hands-on training.

The County also developed protocols to assess the surrounding riparian and in-stream habitat. A rapid habitat assessment is taken every time a monitoring station is visited. A more quantitative physical habitat assessment (such as stream gradient, width, depth, flow rate, stream side vegetation, etc.) is also taken at each station.

Montgomery County's protocols were peer reviewed by state, local and federal agencies and used for more than six years. During this time, Maryland's Department of Natural Resources developed the Maryland Biological Stream Survey (MBSS), which included standardized field methods to monitor fish and benthic macroinvertebrates.

In 2000, Montgomery County, Department of Environmental Protection (DEP), and EPA's Mid-Atlantic Integrated Assessment (MAIA) program executed a Memorandum of Understanding (MOU) to establish a working partnership and a commitment to work together to share information and develop joint products addressing the County's various activities to monitor and evaluate biological resource conditions, prioritize stream protection needs, plan and construct projects to retrofit urban stormwater controls and restore degraded habitats.

In 2001, Montgomery County revised its field monitoring methods to directly compare to those of the MBSS as a result of a comparative study funded by MAIA.

Photo by: B. Batemen

Figure 2. Macroinvertebrate samples collected during stream monitoring.

Photos by: B. Batemen

Figure 3. Angela Chaisson, Andrea Farley, and David Jordahl collect samples.

Outcomes

In 1997, Montgomery County monitored every watershed (23 in total) within its boundaries. The biomonitoring program screened the watersheds, identifying areas of healthy waters and areas of impairment.

Impaired areas were assessed to determine if the impairment was habitat-related or caused by other stressors. Two primary stressors were identified: altered flow and sediment. The County will monitor every 5 years to assess the condition and the success or failure of management actions.

In 1998, Montgomery County published the first Countywide Stream Protection Strategy (CSPS). This document provides stream condition information on more than 200 sub-watersheds within 23 watersheds containing 1,500 miles of streams. An updated CSPS in 2003 will provide information on all County streams.

Once the condition of the streams was determined, Montgomery County combined the results with information about current and future land-use to develop five possible watershed management categories:

- Watershed Preservation Areas
- Watershed Protection Areas
- Watershed Restoration Areas
- Urban Watershed Management Areas
- Agricultural Watershed Management Areas

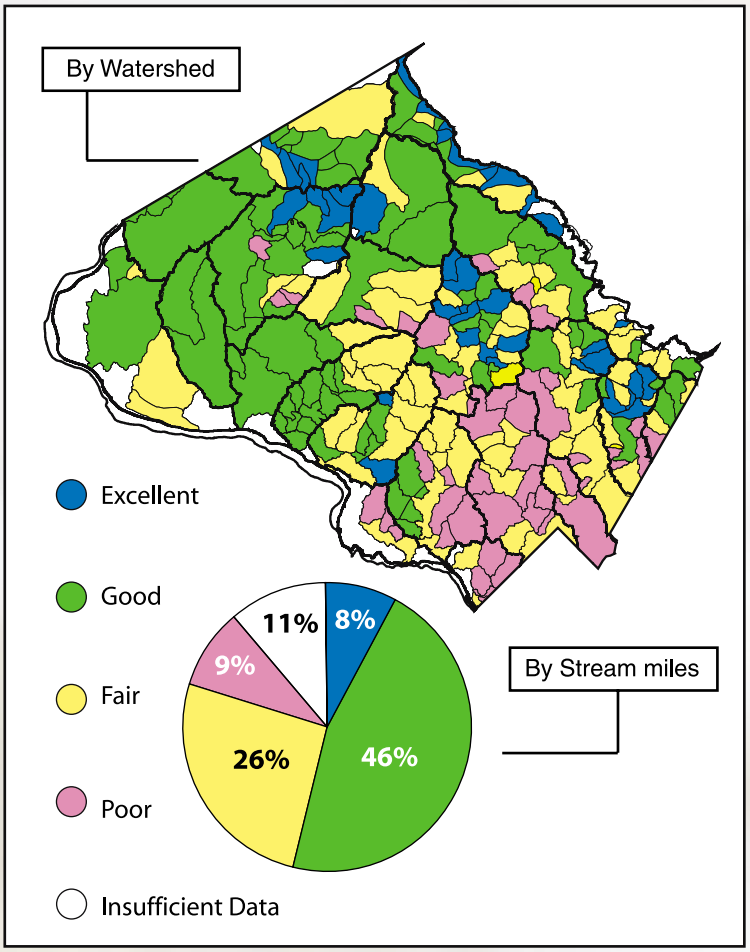


Figure 4. Montgomery County stream condition as determined by the Biomonitoring Program.

Each category has an associated set of prevention or remediation efforts.

An excellent stream running through public lands would qualify as a Watershed Preservation Area. Public policy for such an area could include dedication of the area as parkland, creation of easements for conservation or agricultural preservation, and restrictions on future land-use. Fair or poor streams running through heavily developed/impervious areas qualify as Watershed Restoration Areas. Policy responses could include new stormwater controls, restoration of stream habitat, public education campaigns, or increased forested buffers.

Before Rehabilitation

Paint Branch Montgomery County, Maryland

After Rehabilitation

The County used the CSPS to prioritize its watershed restoration efforts to those areas most in need of immediate remediation. Prioritization was based on the stability of the stream channel and the condition of the stream biotic communities as a measure of the degree of cumulative impacts in the upstream drainage area.

Program Support

Six primary programs support or require the use of information from Montgomery County's biomonitoring program:

1

The ***Federal Clean Water Act*** paved the way for the use of biomonitoring and assessment in public decision-making. A municipal stormwater permit system administered by the states to restore and protect U.S. watersheds, was established as part of the National Pollutant Discharge Elimination System (NPDES). Montgomery County uses biomonitoring to screen all watersheds for areas of impairment at least once every five years.

2

The ***Countywide Stream Protection Strategy (CSPS)*** updates stream condition ratings every five years, resulting in updated watershed management categories and priorities. The Strategy provides a way for planners, managers, and elected officials to understand and consider environmental data as part of their planning process. Montgomery County officials note that it is crucial to provide this information in a timely, concise, and understandable manner to elected officials to allow a more considered understanding of the trade-offs inherent in economic growth.

3

U.S. EPA's Science to Achieve Results (STAR) Grant Program. Montgomery County is a co-investigator with the University of Maryland on an EPA STAR grant. The goal of this grant is to determine how the timing, rate, and spatial configuration of land conversion influences stream habitat and ecosystem health in four watersheds. The grant funds five University of Maryland interns, serving as stream monitors, and the equipment to support this monitoring. The County has timely access to the data being collected, allowing it to be applied immediately.

The County's Special Protection Area Monitoring Regulation is also known as the "Water Quality Ordinance." This regulation assesses the impact of development and designates Special Protection Areas. These are areas with good quality water, but where planned growth is coming. The County wants to maintain the water quality while allowing growth to occur. Under these regulations, the staff first uses fee-supported biomonitoring to evaluate stream condition and then developers provide on-going Best Management Practice (BMP) monitoring.

4

5

Montgomery County's Capital Improvement Program receives grants for watershed restoration. As part of the grant requirements, the County uses biomonitoring to document the success of its restoration programs. Restoration goals are set and assessed through the biomonitoring program.

Maryland Biological Stream Survey (MBSS). Montgomery County coordinates with the MBSS in the monitoring and screening of County waters. Use of the same field monitoring protocols used by Maryland has allowed County watershed assessments to be used for the State's 305(b) report on the condition of State waters and its 303(d) list of impaired water bodies.

6

How Can Other Counties and Local Governments Develop a Similar Program?

A good way to begin is to develop a benthic macroinvertebrate program, collecting specimens and then identifying them in-house or sending them to a taxonomist's laboratory for identification. A benthos-only program in Montgomery County would cost from $1,000 to $1,500 per monitoring station per year in staff, equipment, and analysis fees. Alternately, local officials could develop their budgets for a "benthos only" program by assuming that each monitoring station requires 12 work hours per year − four hours worth of collection, and another eight hours to transport the benthos, identify them, and then develop a stream rating. For counties that send their specimens to taxonomists for identification, assume that any sample containing 100 organisms will cost between $120 and $250 to process. The cost becomes more expensive depending on the specificity of identification (to family or genus) requested.


Photo by: B. Bateman

Figure 5. Montgomery County ecologists (Alicia Bachinsky, David Jordahl, and Mark Sommerfield) taking fish samples.

Adding a fish component requires an additional level of commitment in terms of staffing. It costs an additional $1,500 per station per year, because of the expertise required to catch the fish and identify them immediately. For the first few years of its fish program, Montgomery County relied heavily on volunteer support, requiring a minimum of four people to collect, identify, and release fish quickly.

Counties conducting habitat monitoring or additional chemical testing usually require two- or three-person teams.

Much of the success of the program depends on the personal involvement and leadership of local officials and capable volunteers. Participation in statewide and Chesapeake Bay watershed monitoring groups (the Maryland Water Monitoring Council and the Tributary Strategy Teams) has allowed County officials to interact with, and learn from other experts. Leadership in the community is essential. Community groups such as the Audubon Naturalist Society, the Glen Preservation Society, and the Eyes of Paint Branch, have helped secure and maintain funding for biological monitoring by elevating the issue to the County Council level, frequently attending the Council's working sessions, and making statements in support of the program. The Glen Preservation Foundation and the Audubon Naturalist Society also run annual training programs, preparing volunteers to help local officials conduct their spring and summer macroinvertebrate monitoring programs in Maryland, Virginia and the District of Columbia.


Photo by: B. Batemen

Figure 6. Montgomery County ecologist, David Jordahl, taking water samples.

Montgomery County initially approved two full-time positions, a monitoring vehicle, and necessary additional equipment. Today, the County's Watershed Management Division is supported by a $228,000 annual budget, of which about $180,000 goes toward the salaries of four full-time biologists and two interns. The remainder pays for equipment and other expenses.

KEY LESSONS
That May Be Helpful to Other Local Jurisdictions:

1 Develop PROGRAM GOALS

Because of the natural differences in water bodies, residential, commercial and industrial developments, and political and budget constraints, every county should develop its own goals and parameters.

2 Decide on the LEVEL OF EFFORT needed to begin

Goals should include the level of effort needed to begin and plans for optimal levels in the future. In this regard it is important to determine how much the community can afford to pursue. Start out small and build the program in stages (see previous page). The level of data obtained should not exceed that necessary to develop the minimum amount of information needed to make decisions.

3 COORDINATE with state officials

Interaction with state and federal monitoring programs can help to facilitate data sharing in the future, saving time and money.

4 Be CREATIVE when seeking FUNDING

This includes the use of volunteers, partnerships, grants, and developer fees.

5 THINK through the type of reports that will be needed

Understanding your audience is an important aspect as well. Knowing how the final report and presentation will be used can help determine the number of hours and expertise needed on staff, saving money in the long run. Strive to make reports understandable to decision-makers and the public.

6 Conduct PUBLIC OUTREACH programs

Public outreach programs allow the community to interact and participate in the discussion and development of protocols and ideas in their area. Public outreach can include materials posted on the Internet, posters and brochures, media advertisements, and coordination with other government outreach efforts.

7 BUILD SUPPORT with elected officials and budget staff

The elected officials and budget staff should be included in the decision-making process as well. The biomonitoring program must be understandable and relevant because these officials will ultimately decide whether the programs receive the resources they need.

8 Maintain QA/QC control throughout each stage

The proper identification of species found in the local waters is essential and requires on-going training and reviews of field, lab, sample preservation and shipping, data entry, and data management techniques. Everything from sampling design to the final report has a margin of error that officials can predict and for which they can prepare. Look to state monitoring programs for quality assurance/ quality control (QA/QC) assistance.

Practicing these steps and a little creative financial planning will ensure the success of any biomonitoring program in every county.

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Partnerships and Coordination

Collection of stream data is a joint effort among the Montgomery County Department of Environmental Protection (DEP), the Maryland National Capital Park and Planning Commission (M-NCPPC), and the Maryland Biological Stream Survey (MBSS). Watershed monitoring is coordinated so efforts are not duplicated. Biomonitoring has become a widely accepted tool to measure the degree of cumulative impacts in local streams and rivers and an effective way to communicate the condition of these waters to the public and decision makers within federal, state, and local governments.

- The data is used by DEP to assess the overall health of County streams, while the M-NCPPC uses the data in the master- and park-planning processes.
- The Countywide Stream Protection Strategy (CSPS) has become a vital and useful tool for County agencies to better manage watersheds and to communicate the results of their management programs.
- Use of the same field monitoring protocols used by MBSS has allowed County watershed assessments to be used for the State's 305(b) report and its 303(d) list.
- Recently, County biologists have coordinated follow-up biomonitoring of several point sources of pollution with the Maryland Department of the Environment. This collaboration enabled the County to better understand the condition of its streams and possible stressors causing localized impairments.
- Involvement with the academic community has provided the County a new resource for the exchange of ideas, data, and new ways of evaluating how land-use conversion impacts stream habitat and ecosystem health. New ideas about stream processes provide insights into the evaluation of stream restoration.

MAIA Best Management Practices Case Studies Course

Organizations throughout the Mid-Atlantic region have developed and implemented unique approaches to respond to environmental problems and concerns. The Mid-Atlantic Integrated Assessment (MAIA) has also conducted considerable research in the region, much of which has been used by managers to meet their responsibilities.

MAIA and UMBC initiated a graduate-level research seminar where students document these success stories so that other managers and organizations can also use these approaches and research.